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Agricultural Marketing Service

Marketing Research Division

U.S. DEPARTMENT OF AGRICULTURE

AMS 232

A WAREHOUSE LAYOUT FOR A FRUIT AND VEGETABLE SERVICE WHOLESALER IN A TERMINAL MARKET

By Robert K. Bogardus, industrial engineer
Transportation and Facilities Branch
Marketing Research Division

As used in this report, the term "service wholesaler" means a wholesale distributor who obtains orders for fruits and vegetables through salesmen or by telephone and who makes deliveries to his customers.

In recent years, many distributors located on terminal markets have given serious thought to the problems of shifting over to a service wholesale type of business. In order to operate at the lowest costs possible, they have considered adopting new equipment and improved methods of handling fruits and vegetables. The wholesalers have also recognized the need for remodeling existing facilities to accommodate the new equipment and to provide for efficient warehousing.

The Agricultural Marketing Service is conducting engineering research which involves the development of warehouse layouts for different scales of operation. The research reported here was designed to provide service wholesalers with guides for the layout of a warehouse within a modern terminal market facility. The basic volume selected was 1,000 carloads annually. A suggested layout for a warehouse in which the depth was limited to 100 feet is shown in figure 1 (p. 6 and 7). 1/ Provision was made in this layout for an orderly expansion of the facility to handle 2,000 carload equivalents. Figure 2 (p. 6 and 7) shows the suggested layout after expansion.

Wholesalers on terminal markets who do not handle a general line of commodities or who would not be engaged in a service wholesale type of operation would require a different layout for their activities.

LAYOUT REQUIREMENTS

Characteristics of the Service Wholesale Business

The following assumed characteristics of a service wholesale enterprise were used to determine the amount of floor space required as shown in both layouts:

1. Of the 1,000 carload equivalents handled annually, railroad receipts account for 450 carloads and motortruck receipts for 550 carloads.

1/ The layouts were developed by the McPherson Company, Architects and Engineers, Greenville, S. C., under a research contract with the U. S. Department of Agriculture.

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2. Eighty percent of the total annual volume is handled in an 8-month period from early fall to late spring; the remaining 20 percent is handled during the 4 summer months. During the 8-month peak period, the average weekly receipts by rail are 10 carloads and by motortruck 13 carloads.

3. The maximum volume shipped out on any 1 day is 6 carloads. This quantity is loaded out on 16 delivery trucks having an average load per truck of approximately 6 tons.

4. A maximum volume of 1 carload equivalent of bananas is to be cut and packed daily.

Storage Requirements

The total annual volume of fruits and vegetables handled was divided into four categories on the basis of differences in temperature and humidity required to provide optimum storage conditions. Whenever package strengths permitted, all loaded pallets were to be stored two high.

On the basis of this breakdown, a general storage area, to be held at a temperature of 50° F., would be required to store 7 carload equivalents of cantaloups, onions, potatoes, sweetpotatoes, tomatoes, and related items. A dry cold-storage room, in which the temperature would be 32° F. and the humidity would vary between 85 and 90 percent, would be required for storing 5 carload equivalents of apples, grapefruit, grapes, lemons, lettuce, oranges, peaches, and related items. A wet cold-storage room also would be required, in which humidity would be maintained at between 90 and 95 percent and the temperature at 32° F., for storing a total of 3 carload equivalents. Items stored under these conditions include cabbage, carrots, celery, corn, and similar commmodities.

Four banana ripening and holding rooms, having temperature ranges of 56 to 70° F. and humidity ranges of 85 to 95 percent, would be needed. Four carload equivalents of bananas would be stored in these rooms. The temperatures maintained in the banana cutting and packing room would be 56 to 60° F.

Materials-Handling Methods

In developing these layouts, it was assumed that commodities, other than bananas, received both by railroad car and by motortruck, would be built into unit loads on 40- by 48-inch wood pallets on the receiving platforms. These loads then would be picked up by electric pallet transporters or forklift trucks, and transported to and placed in storage. These methods involve the use of an industrial forklift truck having the capacity to handle a 2,000-pound load and to elevate it high enough to place one pallet load on top of another. The same equipment would be used to move the unit loads from the storage areas to positions immediately adjacent to the conveyor.

A portable belt conveyor with a retractable cantilevered extension would be used to move the commodities into delivery trucks. Four-wheel hand platform trucks, having superstructures for hanging stems (bunches) of bananas, would be used for receiving that fruit. The stems of green fruit would be hung manually from ceiling hooks in the ripening rooms. The stems of ripe bananas would be transported to the cutting and packing areas on the same equipment.

LAYOUT CONSIDERATIONS

In developing the layouts discussed in this report, several factors were considered to provide for an efficient warehousing operation in an existing building. Space requirements were based on the volumes of fruits and vegetables to be handled as well as the types of materials-handling equipment to be used. The tonnages of each commodity to be stored determined the number of loaded pallets for which storage space was required. The pallet size (40 by 48 inches) plus clearances for ease in movement and positive air circulation established the storage areas needed. In addition, aisle widths were made great enough to provide easy access to all commodities.

The various warehouse components were arranged in such a way that the distances that commodities had to be moved were kept as short as the length of the building would permit. Conveyors, for truck loading, were located so that movement from storage to the conveyor line was kept as short as possible. Enough space was provided along the conveyors to permit the temporary storage of complete pallet loads of commodities required to satisfy customer orders.

Pallets loaded on the receiving platform were not to be unloaded until they were placed in the conveyor area for delivery-truck loading. Warehouse doors, aisles, and storage areas were arranged so that these materials-handling systems could be used efficiently. Provision was made also for supplementary systems for handling bananas and for other warehouse operations.

Both the initial and expanded layouts were designed to minimize the number of store units required for the specified business volumes. The initial layout (fig. 1) would require 13 store units, each 22½ feet wide, and the expanded layout 21 units. Figure 3 shows a typical elevation and plan for one store unit of a modern terminal market.

If a service wholesaler did not plan to do any prepackaging or to ripen green tomatoes, fewer store units would be required.

ARRANGEMENT AND FUNCTIONAL USE OF WAREHOUSE COMPONENTS

Receipts palletized on the rail or truck platforms would move over direct paths to their designated storage areas. During the assembly operation, unit loads on pallets would be withdrawn from their respective storage areas. Palletized loads of packed boxes of bananas would be picked up from the

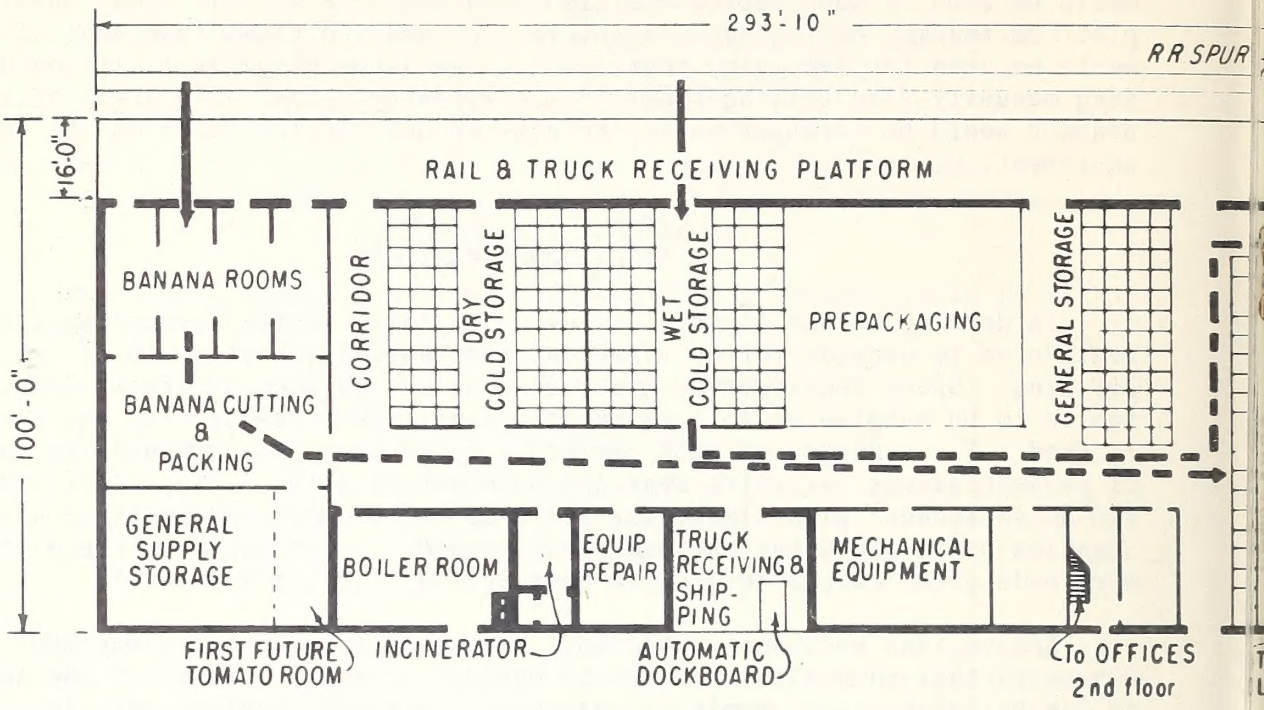

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Figure 1.--Layout plan

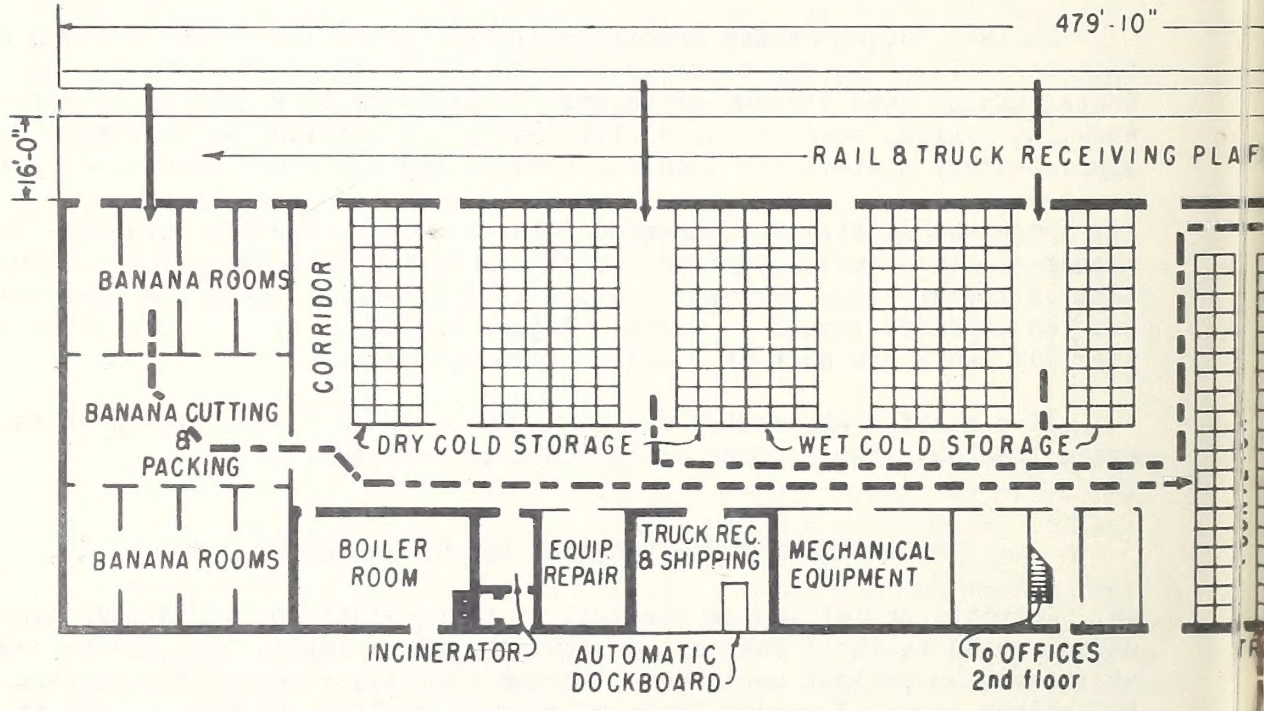

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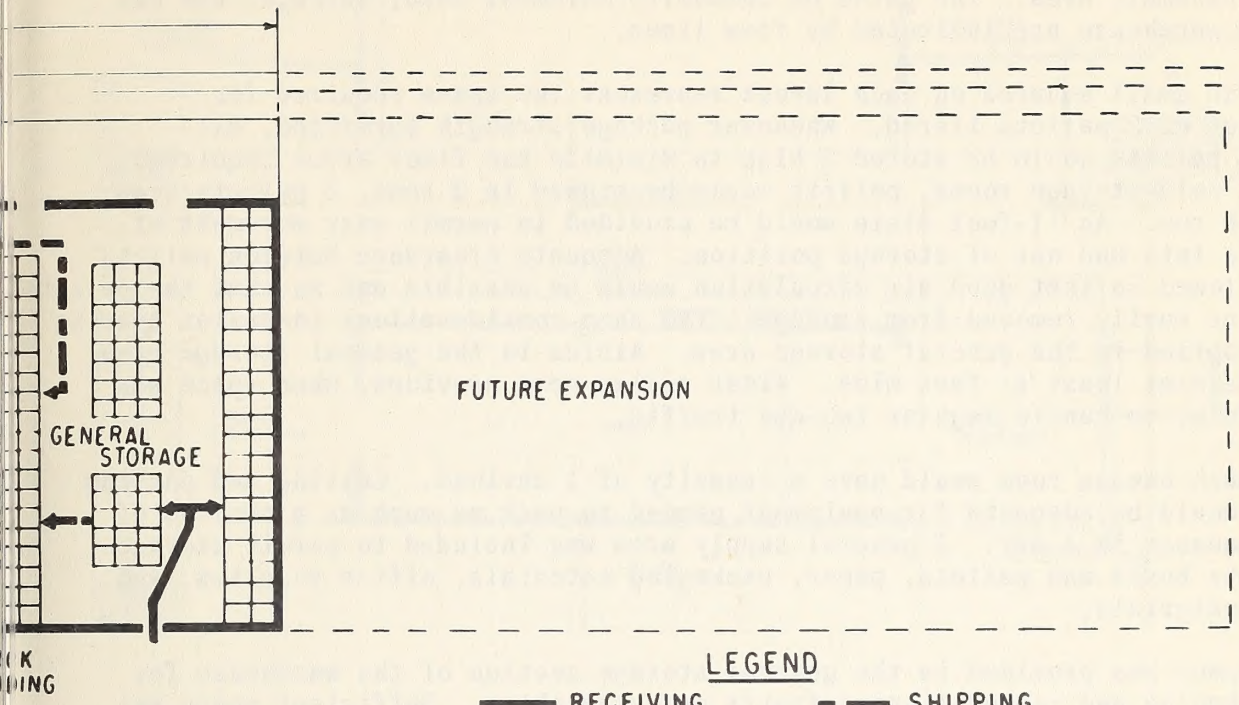
Figure 2.--Layout plan



,000-carload annual capacity.

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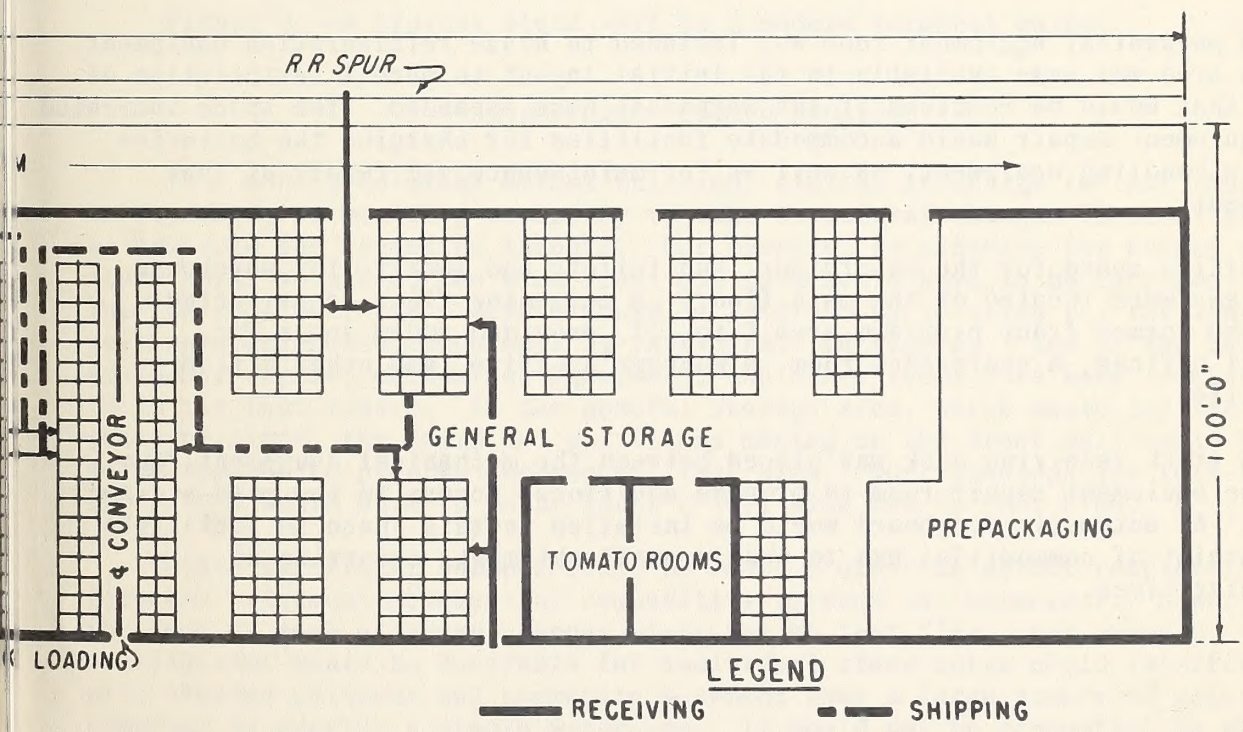

,000-carload annual capacity.

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banana-cutting room or from a holding room. All loads would move to the order assembly area. The paths of commodity movement into, through, and out of the warehouse are indicated by flow lines.

The small squares on each layout represent the space required for 1 pallet or 2 pallets tiered. Whenever package strength permitted, all loaded pallets would be stored 2 high to minimize the floor areas required. In the cold-storage rooms, pallets would be stowed in 2 rows, 3 pallets deep in each row. An 11-foot aisle would be provided to permit easy movement of pallets into and out of storage position. Adequate clearance between pallets was allowed so that good air circulation would be possible and so that the pallets could be easily removed from storage. The same considerations in pallet spacing were applied in the general storage area. Aisles in the general storage area were made at least 11 feet wide. Wider aisles were provided, when space was available, to handle regular two-way traffic.

Each banana room would have a capacity of 1 carload. Cutting and packing space would be adequate for equipment needed to pack as much as a carload of ripe bananas in 1 day. A general supply area was included to permit storage of empty boxes and pallets, paper, packaging materials, office supplies, and other materials.

Space was provided in the general storage section of the warehouse for prepackaging and reconditioning fruits and vegetables. Sufficient space was left for installation of equipment for a small prepackaging operation. If tomatoes were ripened in this warehouse, the sorting and packing tables would be located in this area, along with the overwrap machinery.

A mechanical equipment room was included to house refrigeration equipment. Enough area was made available in the initial layout to permit installation of units that would be required if the warehouse were expanded. The space indicated for equipment repair would accommodate facilities for charging the batteries used in handling equipment, as well as for maintenance and repair of that equipment.

Office space for the supervisor, and toilets and lockers for warehouse employees were located on the main floor. A mezzanine floor, constructed over the former front platform area (fig. 3), provided added space for general offices, a conference room, a manager's office, and other office facilities.

A truck receiving dock was placed between the mechanical equipment room and the equipment repair room to provide additional access to the cold-storage rooms. An automatic dockboard would be installed in this space to facilitate the receipt of commodities and to handle small shipments occurring at irregular times.

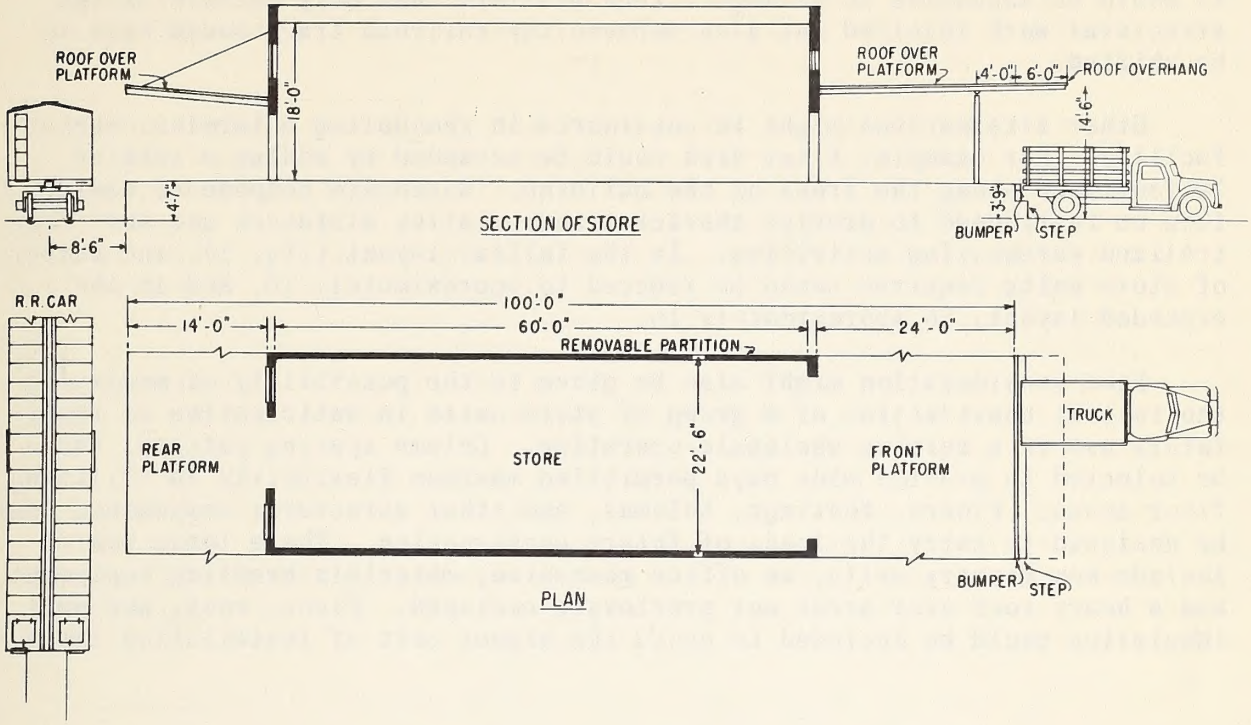

Figure 3.--A typical store unit in a modern terminal market.

STRUCTURAL CHANGES REQUIRED

In a modern terminal market building, similar in design to that shown in figure 3, it would be necessary to make structural changes in order to accommodate the suggested layouts. For example, to minimize the number of store units required, the wide front platform would have to be enclosed. The low roof over the platform could be retained by locating all the low-ceilinged warehouse components in that area. In figures 1 and 2, the boiler, equipment repair, mechanical equipment, and other rooms have been located there for that reason. In the general storage area, which would include the conveyor lines, the doors and partitions making up the front wall would have to be removed to provide the needed floor area. Door openings for fork-truck operations would have to be at least 6 feet wide and 7½ feet high.

Other structural changes could be made in order to permit completely free and efficient movement of commodities through the warehouse. However, the cost of some of these changes might not be justified. For example, column spacing that would be desirable for individual store units could interfere with storage patterns and commodity movement when a large number of units were combined to provide a single warehouse. It would not be economical to change a basic column plan. Another example would be the provision of a rear platform depth of at least 16 feet to accommodate forklift-truck operations.

It would be expensive to enlarge a rear platform, not only because of the structural work involved but also because the railroad track would have to be shifted.

Other alternatives might be considered in remodeling a terminal market facility. For example, floor area could be expanded by adding a section 30 feet deep along the front of the building. Warehouse components could then be rearranged to provide shorter transportation distances and more centralized warehousing activities. In the initial layout (fig. 1), the number of store units required could be reduced to approximately 10, and in the expanded layout, to approximately 16.

Some consideration might also be given to the possibility of modifying the initial construction of a group of store units in anticipation of their future use in a service wholesale operation. Column spacing patterns could be selected to provide wide bays permitting maximum flexibility in utilizing floor space. Floors, footings, columns, and other structural components could be designed to carry the loads of future construction. These loads would include new masonry walls, an office mezzanine, materials-handling equipment, and a heavy roof over areas not previously enclosed. Floor, roof, and wall insulation could be included to avoid the higher cost of installation later.